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Forestry Research West

May 1993

A report for land managers on recent developments in forestry research at the four western Experiment Stations of the Forest Service, U.S. Department of Agriculture.

Forestry Research West

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Cover

A northern sagebrush lizard crosses a fresh accumulation of woodrat midden. Scientists at the Intermountain Station are sifting through and studying midden (flowers, grass, bones, sticks and other objects that are collected and stored by desert rodents). They believe that these rodent "trash heaps" hold keys to better understanding climate change, ecological conditions of plant communities, and even what tree species to plant in the year 3000. Read about this unique study, beginning on page 1.

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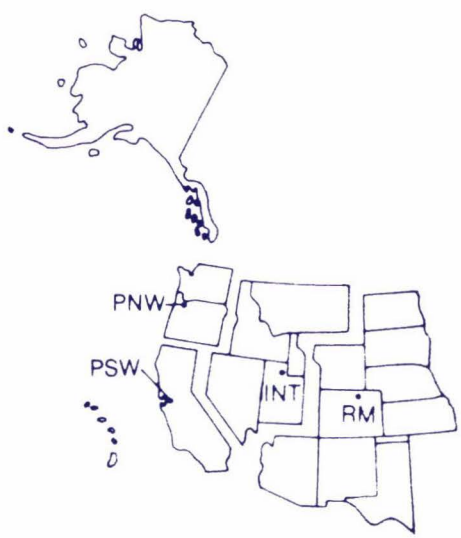


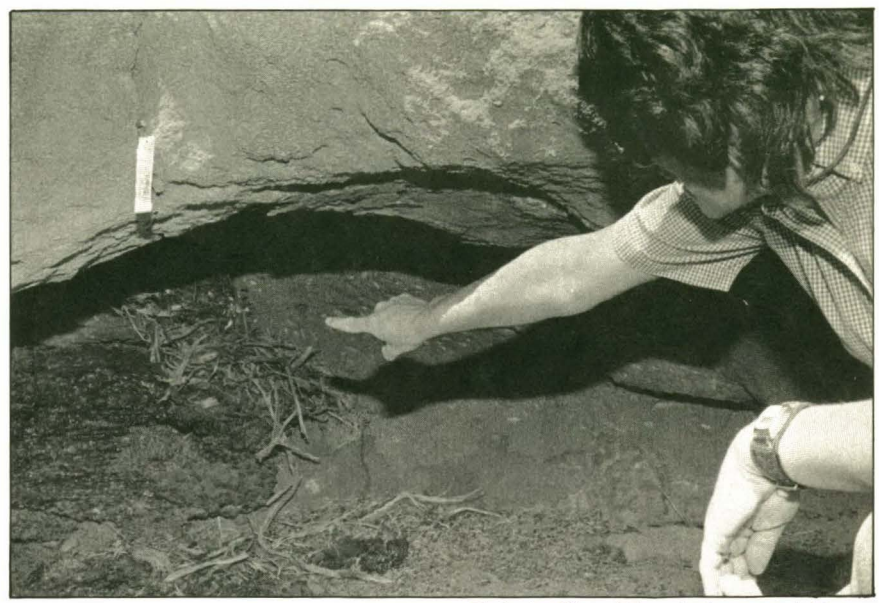
Prehistoric past provides clues for the future

by David Tippets
Intermountain Station

For over 30,000 years generations of small desert rodents called woodrats packed flowers, grass, bones, sticks, and almost anything else that appealed to them into the crevices of cliffs where they built their nests. Whatever they didn't eat they dragged onto the trash heap near their nest. Unlikely as it may seem, those trash heaps may be the key to answering some of the most important scientific questions of our time.

Is our climate and biosphere changing? What is the ecological condition and potential of plant communities? What kinds of trees should people plant to have healthy forests in the year 3000? What crop species should we plan to plant in the Midwest to feed a population doubled in size? All of these questions can be better addressed by studying the record of past vegetation and climate changes recorded in rodent trash heaps.

Scientists refer to these prehistoric collections as middens. During the time period contained in woodrat midden fossil records, ice-age glaciers made their maximum advance south near the end of the Pleistocene, 18,000 years ago. Then the climate changed dramatically—glaciers retreated. As the Holocene began, many large mammals, including the mammoth and the camel, which once grazed on the same plants collected by the woodrats, became extinct. But the woodrats survived and went on living in the same caves.



Biologist Cheryl Nowak shows a midden where samples have been taken for radio carbon dating and identification of the macro fossils.

In the Reno, Nevada Forestry Sciences Laboratory, Range Scientist Robin Tausch recently unrolled a plastic garbage bag, revealing a chunk of midden that looked like cold tar with bits of juniper leaves, tiny rabbitbrush flowers, and other plant litter stuck to it. As the air circulated around the exposed midden sample, slowly the laboratory began to smell like a cave, or more precisely like a woodrat midden. Tausch pointed to the macro fossils and explained how the science of paleoecology uses fossils to learn about ancient ecosystems and environments.

"As we discover past trends and variation in plant communities, we are changing our beliefs about the ability of plant communities to progress toward a climatic equilibrium," Tausch said. He explained that woodrat-preserved fossil history reveals communities always in a state of change in a continually changing climate.

Like a heat-seeking missile

"Plant communities are like a heat-seeking missile," Biologist Cheryl Nowak elaborated, describing the historical climate of the Great Basin as a constantly moving target that plant succession always chases. Just as the missile is about to hit the target, the

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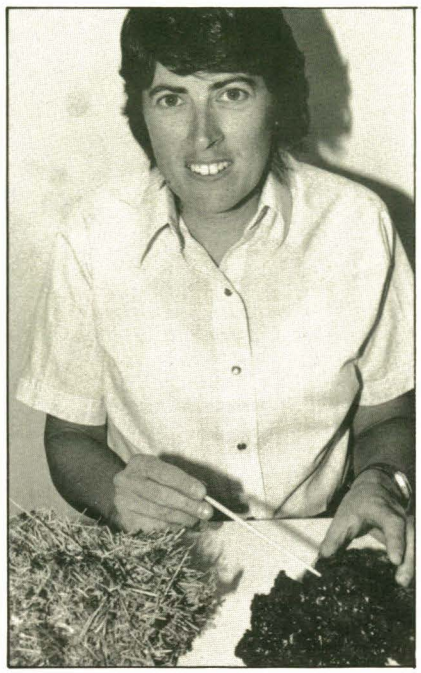
climate changes direction and succession in the community changes to follow it, never really achieving climax, the kind of equilibrium theorized by early ecologists.

Through research conducted at the Intermountain Station's Reno laboratory, in cooperation with the Desert Research Institute of Reno, scientists found that woodrats collect and preserve a record of their environment that provides new understanding about how to manage natural resources.

New middens look like a nest of twigs and grass, but old middens look like a shiny mass of tar plastered into crevices of desert cliffs. Inside the rock-hard black mass lie hidden the fossils that tell stories about the ancient ecosystems that once thrived around the cliff. Because the black casing is crystalized woodrat urine and is water soluble, fossils are only preserved in middens where the casing is protected from rain. In wetter climates and areas without rock cavities the urine dissolves and the fossil record is lost.

Urine as a building material

Woodrats seem vividly aware of the usefulness of their urine, using it as a building material in much the same way swallows use mud to build nests. Once Tausch left a cardboard map tube lying near a midden. When he returned both ends of the tube were plugged with litter glued together with the



Biologist Cheryl Nowack shows fossilized midden material preserved in woodrat urine compared to fresh midden material on the left, not encased in the crystalline urine.

crystallized urine. On examining the tube, he learned that a woodrat had filled the center of the tube with food then sealed the ends. With what appears to be an equal level of awareness, woodrats build an armor plate around the outside of their nests for protection by coating the nest with their own urine.

"I am more likely to have my fingers disinfected from handling the middens than get germs," Tausch says. "After you get used to handling midden material you can sit down next to the midden and eat a sandwich." Tausch explains that his attitude about handling the urine-encased fossil is created by the knowledge that the urine contains natural chemicals that kill both fungus and bacteria. This property helps prevent decay and preserves the fossils within the middens.

The middens preserve a record of ecological history not just because the crystalline urine is so ideal at preserving it, but also because the woodrats are so industrious at collecting data. In any research that depends on fossils, scientist need to know the collection and deposition processes for the fossils they are studying.

Packrats pack

Woodrats are also called packrats because of their instinct to pack things back to their nest. They pack food and nest material, and they pack home to their nests anything that happens to catch their eye. Although they are strict vegetarians, they like bones. They like shiny rocks, whether they happen to be just a stone or an obsidian arrow head.

To casual observers, these nocturnal rodents resemble squirrels as much as the bald-tailed sewer rats that many people envision when they think of a rat. Of the 20 species of the genus *Neotoma,* two live in the northwestern Nevada study site. Both species' tails grow hair, but one species, commonly called the bushy-tailed woodrat, is most common.

Woodrats opportunistically search for the best spot in a rock crevice to build a nest, making the middens a jumbled mass of different ages of fossils. The scientists look for natural layers and separations, and then radio carbon date each layer.

Mother midden

The oldest midden under study, the one that contains 30,000 years of history, sits back in a large vertical crack that rock climbers would call a chimney. A series of natural shallow roofs deflect the rain above the chimney. Dr. Peter Wigand of the Desert Research Institute discovered the midden and affectionately calls it his "mother" midden, Tausch says.

Intermountain Station and Desert Research Institute scientists have found other middens nearby that provide abundant samples of the younger fossil evidence, but Tausch is still searching for more fossil samples of the earlier ecosystems with their associated climates. The problem is, as time has passed, the rocks that once protected the middens have weathered, cracked, and fallen from the cliffs, exposing the oldest middens to the rain that dissolves the crystalline urine.

In the laboratory, scientists intentionally dissolve the crystals from the black mass, placing dated midden chunks in large beakers to free the fossils. Technicians sort the fossils first by size through a series of sieves. Then begins the tedious process of examining everything under a dissecting microscope to sort bones from seeds and leaves from flowers.

DNA analysis reveals climate

Using the most advanced techniques of molecular biology, scientists at the Reno laboratory, in cooperation with Dr. Paul Keim at Northern Arizona University, have begun to discover even the level of hybridization of some species through DNA analysis. Hybridization between Utah juniper (*Juniperus osteosperma*) and western juniper (*Juniperus occidentalis*) in particular, provides revealing information about climate and plant adaptation. This genus possesses great genetic variability, giving it the ability to hybridize and adapt to climate change.

Juniper, like big sagebrush and rabbitbrush, forms groups of populations that share a common gene pool. In a recent development in genetics, such groups are now known as coenospecies. This Great Basin paleoecology research adds supporting data to the concept of coenospecies and in turn suggests that our traditional concept of species may not fit real ecological processes of the Great Basin.

Juniper is the only tree to have a continuous fossil record in Tausch's Painted Hills study site. It may be that it hasn't been just one species or the other, but rather a continuum of hybrids more closely approaching one species during the wet climatic variation, and then more closely approaching the other species during the drier climatic variation.

After studying DNA in the juniper, Tausch believes that juniper showing up in the middens are those that were best adapted to the climate during seedling establishment. Continued study of juniper alone should reveal much about climatic variation during the last 30,000 years.

Why land managers should care

Why should resource managers care about climatic variation for the last 30,000 years and why should Forest Service scientists devote time to what may seem to be such fundamental and pure science? The potential implications to resource management are dramatic.

For 30,000 years fossil records show that plant communities were constantly changing to adapt to changing climate, and never stabilized at what is thought of as a climax stage of succession.

The concept of managing vegetation to achieve climax communities, a concept developed by pioneer plant ecologist F.E. Clements and championed in application by early Forest Service scientists, such as A.W. Sampson and C.L. Forsling, may be obsolete. Clementsian ecology proposes that plant communities progress through a process of dynamic change that Clements called succession until they reach a state of equilibrium with climate at climax.

"Succession as a process of vegetation change is real," Tausch says, "but climax is not." Clements's paradigm of a climax equilibrium can only work as long as climate remains constant. The reality of continual climate change undermines the paradigm.

Redefine range condition

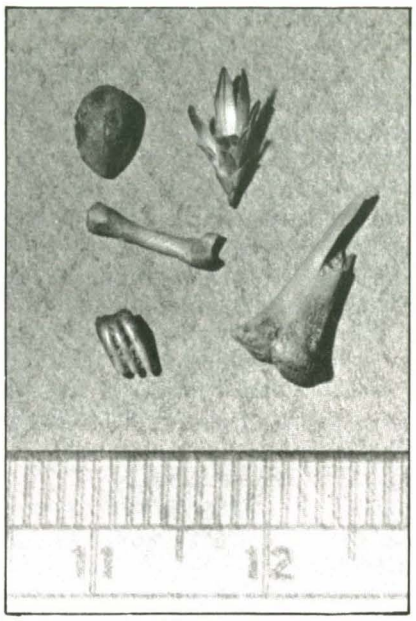
Concepts of range condition were built on Clementsian ecology and if his model of nature doesn't represent the actual ecological process, as Tausch's research indicates, land management agencies need to redefine how they evaluate range condition.

The Society for Range Management is currently working on new concepts of range condition that more accurately reflect ecological processes as scientists now understand them.

Rather than using climax communities as defined in relict areas as the baseline for measurement, managers must include consideration of climate change. They must set a goal for the community at a point of desired future condition that they can hope to intersect as the plant community chases climate through time.

In contrast, past management under concepts of Clementsian ecology has been like shooting a rifle at a bullseye. Management in the reality of a changing climate is more like skeet shooting where you must anticipate alternative paths and aim management practices way out in front of where you can currently see the target, hoping that one of your alternatives will match the direction of the future climate.

The fossil record also shows what variation we can expect in climate. During the last 10,000 years, long periods of time over 100 years in duration with less precipitation than the Great Basin has had during the recent "drought", are common. Decades of long dry periods are more typical of the historic climate than the relatively moist 3 decades of this century that current generations of managers now remember as normal.



Plant and animal fossils preserved in a woodrat midden photographed next to a centimeter scale.

Paleoecology research suggests to Great Basin ranchers and agency managers alike that the current drought should not be thought of as a temporary scourge that will go away, but rather part of a normal climatic cycle that may continue for decades before an oscillation in climatic cycle returns range and crop production to what we may remember as the good years.

"We need to be managing for a successional process on a landscape basis that will sustain the ecosystem," Tausch says, explaining that resource managers must continue to monitor ecosystems on a local basis, but their data must

be interpreted over both time and space on a regional basis. Scientists need to help resource managers by learning how to fit global change, including climate change, into the equation.

Managers can deal with climate changes induced by the "greenhouse effect" and other global change, better, if they first understand the natural pattern of variation prior to human influences on the biosphere and the atmosphere. Paleoecology reveals past cycles of variation with tremendous amplitude, and there is no evidence that we are not still in a changing cycle. The most significant news of the greenhouse effect is not that the climate will change, but first, that the rate of change will likely be faster than anything in the fossil record—faster than the change at the end of the Pleistocene when many large mammals failed to adapt and became extinct. Second, the greenhouse effect may break the cycle and send the world off in a new direction.

Tausch predicts that we will continue to see rapid new mixing of species in plant communities. The combined effect of the invasion of exotics, such as cheatgrass and leafy spurge, combined with climate change will transform Great Basin plant communities.

Range Scientist Robin Tausch (left) and ARS Research Technician Ellen Martens processing DNA from juniper that will help reveal new knowledge about how plant communities adapted to 30,000 years of climate change in the Great Basin.

"The implications for economic and political systems are tremendous," he says. "It's not hard to imagine how our quality of life could be threatened by global change."

Civilizations can fail

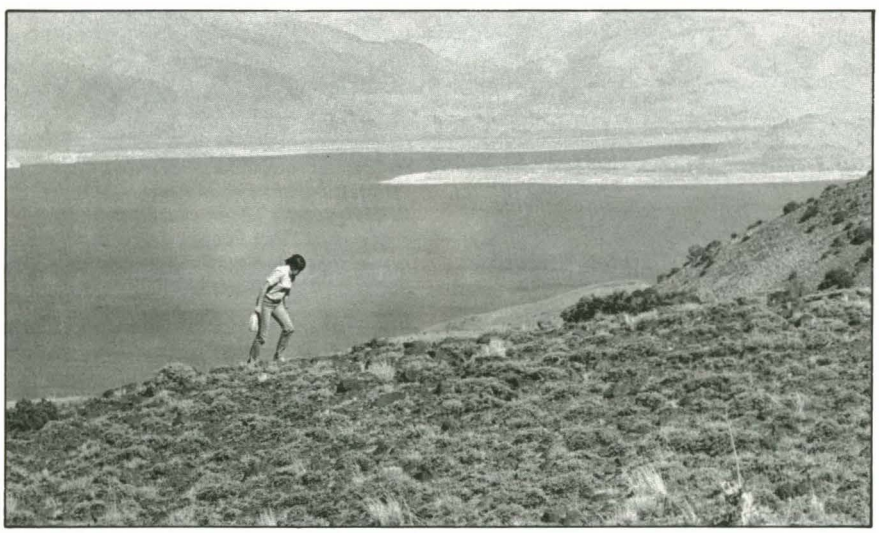
History offers many examples of civilizations that failed to detect early enough changes in their environment and fell into ruin.

Easter Island, the Anasazi culture of the American Southwest, and the lost city of Petra in Jordan that was once a center of commerce during the Roman empire all provide examples of civilizations that crashed as a result of environmental change. In the cases of the Anasazi and Petra, midden records preserve the story of environmental change that undermined the civilization. They show the value of being able to look back at the past to see the potential for human disaster in the future.

In many examples of failed civilizations, climate change has been blamed and then the blame later shifted to human impacts of self destruction, as in the case of the Anasazi. But what if accelerated climate change compounds the impacts of rapidly expanding human population and the introduction and mixing of exotic species? Certainly the potential destabilizing force is even greater.

Tausch suggests that climate change is so slow from our perspective that most people fail to understand the magnitude. When viewed by daily increments the change is imperceptible. But over time the change can be too great for some species and perhaps even humans in some areas to adapt to.

"It's like termites in a house," Tausch suggests. "They can be there for some time and unless you know just what to look for they won't even be noticed. By the time the piano goes through the floor the house is generally a total loss. As with termites, most people haven't learned what to look for to recognize the cause and effect of global change."



Biologist Cheryl Nowack leans into the wind as she hikes across a range relict area above Pyramid Lake, Nevada. Scientists once thought that this plant community, protected from domestic grazing because of its distance from fresh water, represented an example of a climax community.

From Tausch's paleoecology research, he now understands that the community is no longer adapted to the current climate and once disturbed will not have the ability to return to its present condition.

The potential impacts of global change on civilization may be greater in the more productive corn belt States than in the Great Basin, but the arid Great Basin is a more sensitive barometer to measure and monitor the change.

"The aridity provides for long-term preservation of several paleo-records," Tausch says, "and the rainshadow of the Sierra Nevada and Cascade Mountain chains makes the area very sensitive to environmental changes that can go undetected in more mesic situations. Many of the changes are enhanced or magnified by the topography of the region."

Few would guess that Forest Service scientists studying prehistoric rodent trash in the Great Basin Desert would gain new scientific knowledge to help society plan the future production of food and fiber so important to the stability of civilization. And while some are still doubting that climate change is real, these paleoecologists examine 30,000 years of fossil history and report that the correct question is not if, but how much and how fast.

Pacific yew: an old species brings new research

by Carolyn Wilson
Pacific Northwest Station

Putting out Pacific yew common garden study in September 1992.

Nan Vance is a woman with a mission. Her assignment? To study the slow-growing Pacific yew tree, and what affects the production of taxol, a new, potent anticancer drug extracted from the bark of the tree.

Vance, a research plant physiologist at the Pacific Northwest Research Station (PNW), is actively involved in this issue and in the viability of the Pacific yew as a species.

Taxol has been successful in the treatment of ovarian cancer. The National Cancer Institute (NCI) has conducted experiments with taxol for the past 10 years with success in treating various forms of cancer.

The Federal Drug Administration (FDA), in December 1992, approved the use of taxol in cancer treatment. The approval, however, magnifies the ongoing issue surrounding the availability of taxol.

"At the present rate of usage, the existing supply of taxol may not be sufficient to meet the demand," says Vance. "The natural supply of Pacific yew is limited, and if the species is to continue as a major source of taxol, the trees will have to be cultivated or other alternatives found."

Although Bureau of Land Management (BLM) has millions of yew trees, the number remaining for harvest following protection measures is quite small according to Kent Tresidder, a BLM yew coordinator. About 55 percent of the trees grow in northern spotted owl habitat, riparian areas where logging is not permitted, and other special management areas.

Factors influencing taxol yields

The potential the drug has for fighting cancer, and the limited supply of Pacific yew, opened the door for Corvallis, Oregon-based researchers Vance and Rick Kelsey to study what affects taxol yields.

"I had observed Pacific yew back in my home state of Montana and recognized it as an important understory species even before the medical research and commercial facets of the tree became known," Vance says. "I was very familiar with where it was growing in the nearby McDonald Research Forest in Corvallis, Oregon, and so was ready when the opportunity for this type of research came along. Rick and I were funded by a grant from the National Cancer Institute to research the culture, physiology, and genetics influencing taxane yields in Pacific yew."

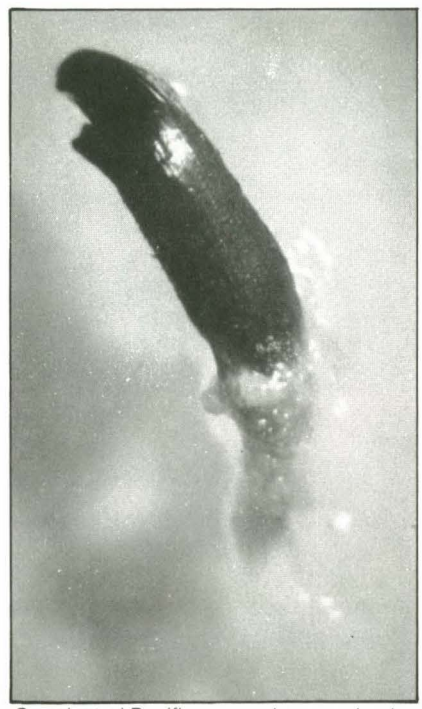
Assessing genetic variations of taxanes in Pacific yew across a broad geographic range is the focus of one study funded by the NCI grant. A common garden study of 50 Pacific yew clones has been initiated. Ramets (individual members of clones) have been successfully rooted and are outplanted (transplanted) in a random design in beds at the Corvallis laboratory. Analysis will be complete by the end of 1993.

Vance and Kelsey also conducted a study on yew trees that were under a forest canopy and growing in a clearcut in the McDonald Forest. The study revealed that taxol is significantly higher in bark than in twigs and needles and higher in shaded trees than in trees grown in full light.

Harvesting foliage rather than bark

Vance, Kelsey, and Tom Sabin, a statistician with the Oregon State University Department of Forest Science, completed a study in 1992 to determine if there are differences in taxol concentrations in the bark of yew.

"We are developing a model to determine the distribution of taxol in the bark of the bole and limbs. We also want to be able to accurately determine bark mass on trees by using simple field measurements," says Vance.



Germinated Pacific yew embryo excised from seed.

"Results of the study show that taxol amounts decrease in a gradient from the base of the tree bole (trunk) up to the limb tip. The mean taxol concentration in the branch bark was about one-third of that in the bole, but the number of branches, which ranged from 10 to 20, made their contribution to the total taxol yield important," Kelsey adds. "The taxol in foliage was about one-tenth of the amount in bark. Other taxanes, which can be converted to taxol often are more abundant in foliage, however.

"Harvesting foliage rather than bark may have an advantage, in that foliage is renewable and can be collected from cultivated yews including other commercial species.

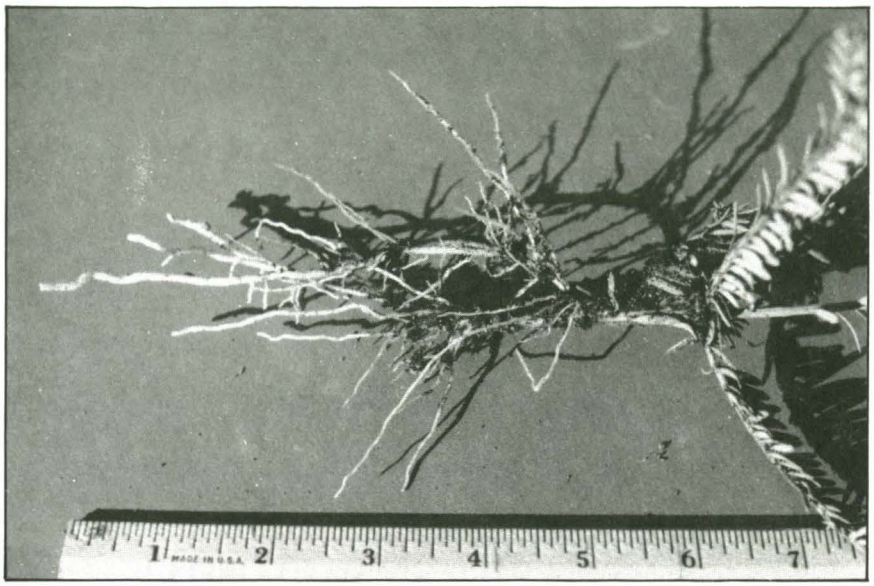
Collaborating with Don Copes, team leader, genetics and tree improvement, and in cooperation with the J.H. Stone Nursery in Medford, Oreg., Vance began regeneration studies of Pacific yew by using rooted cuttings.

"We're really starting from scratch because we know so little about the propagation and growth of this species. Studies are needed to determine the optimal rooting and growing propagation environment and procedures, such as hormone applications and when to stick cuttings."

So far, Copes and Vance have run tests on 1,000 cuttings in 1990 and 2,150 in 1991. Stecklings (rooted cuttings that produce clones) from both years have been planted in outdoor beds at the Corvallis, Oregon, Forestry Sciences Laboratory and the J.H. Stone Nursery. Rooting and growth data are being analyzed. The next step is to record data on outplanted stecklings.

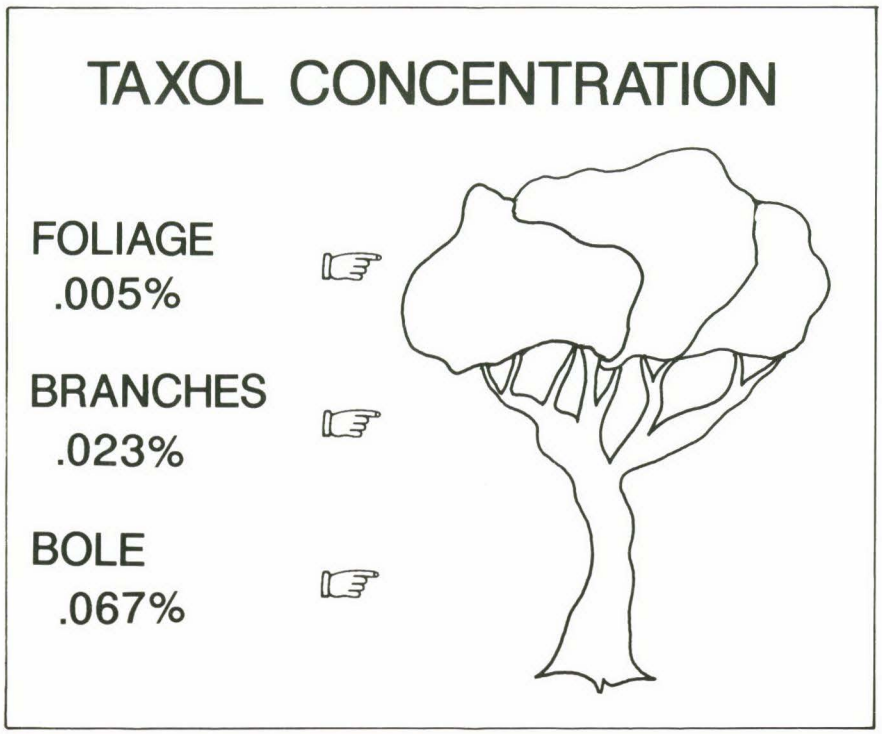
"Although we are working mostly with cuttings, I'm really interested in seed germination studies because seedlings will more likely maintain genetic diversity and more readily grow into a tree form. The problem is that seedlings require an extra year to germinate, whereas cuttings put out roots within months," Vance says.

A continual supply of Pacific yew is essential to successful development and commercialization of taxol. Bristol-Myers Squibb, a pharmaceutical company under exclusive contract with the Departments of Agriculture and the Interior to extract taxol from Pacific yew of National Forest System and BLM lands for 5 years, is actively seeking alternative sources that are sustainable. The company also is supporting research and development to extract taxanes from biomass harvest of various yew derivatives into taxol and to produce taxol by plant cell culture.



Rooted Pacific yew cutting.

Semisynthesis, the process of converting taxol derivatives into taxol, is promising because it increases the options for selecting source material, is a selective process that reduces the impurity threshold as required by FDA, and provides patent and licensing opportunities, according to Vance. Rapid developments in the production of significant amounts of taxol by means of semisynthetic drugs is so progressive that new information continues to surface quite frequently.



Taxol concentrations in various parts of the tree.

In 1991, Weyerhaeuser and Bristol-Myers Squibb formed a partnership to find ways to regenerate the Pacific yew.

"We entered into an agreement with BMS in 1991. Our charter is to develop technology that will allow intensive biomass production of yew species as an alternative source of taxol," says Dick Piesch, a Weyerhaeuser representative. "Cuttings are our main approach to propagation in cloning because we know this is a reliable source of taxol."

Implications for future Forest Service research

"Research on fast-breaking issues is something the Forest Service is going to have to deal with," says Vance. "I feel this type of research is a harbinger of having to more frequently address issues and species that, in the past, have not merited much attention."

Vance emphasizes that all the research being done on the Pacific yew is a result of interdisciplinary team efforts that could not have happened in an environment still clinging to specialization."

"The Pacific Northwest Research Station deserves credit for quickly responding to issues within an interdiciplinary framework."

For more information on regeneration of Pacific yew, contact Dave Steinfeld at the J. Herbert Stone Nursery, 2606 Old Stage Road, Central Point, OR 97501. For information on commerical harvesting of yew tree cultivation, contact Dick Piesch, George R. Staehler Forest Resources Center, P.0. Box 420, Centralia, WA 98531.

Reforestation efforts on Kahoolawe continue

by Mark Dougherty
Pacific Southwest Station

Tree species planted on Kahoolawe Island, Hawaii, 20 years ago in State/Federal species trials continue to grow, proving their adaptability to the harsh site conditions found on the "Desolate Island." Two species- horsetail ironwood (*Casaurina equisetfolia*) and tamarisk (*Tamarix aphylla*)- have reached six or more meters in height," says Craig Whitesell, Research Forester of the Forest Service's Pacific Southwest Research Station, Institute of Pacific Islands Forestry at Honolulu, Hawaii. "These trees were planted in soft weather rock and have continuously suffered wind damage, but they're stabilizing what little soil there is," says Whitesell , who visited the uninhabited island in October 1991. "We're seeing site conditions develop that may become suitable for planting less hardy native species sometime in the future."

Tree loss

On the down side, however, Kahoolawe's harsh environment has resulted in the loss of several hundred trees that were planted in the 1970s. Two native species that failed on one or more sites are koaia (*Acacia koaia*) and wiliwili (*Erythrina sandwicensis*).

Twenty-year-old trees in this test plot stand in sharp contrast to the barren, windswept terrain that dominates much of Kahoolawe.

Kahoolawe, located in the rain shadow of 3,055-meter (10,023-foot) Mt. Haleakala on Maui, receives only 200-600mm (8 to 24 inches) of rain a year and is constantly subjected to strong salty winds. Vegetation was always sparse on the 116-kilometer-square (45 sq. mi.) island—the smallest of the eight major Hawaiian islands—and during the early 1900s, ranchers introduced horses, cattle, sheep, and goats.

Ranchers had to remove the horses and cattle during severe drought, but the remaining sheep and goats adapted to the arid climate, multiplying rapidly. By the 1970s, 5,000 or more animals thrived, overgrazing the ground cover.

The goats destroyed the natural regeneration—even hardy plants like kiawe (*Prosopis pallida*) that grow on Kahoolawe, says Whitesell. "The results was a worsening of the erosion. The need to reverse the effects of decades of grazing is one reason our restoration work is so important."

A joint effort

The grass and tree planting project, a collaborative effort of the Hawaii Department of Land and Natural Resources, and three federal agencies-the U.S. Navy, which controls Kahoolawe, the USDA Soil Conservation Service and the USDA Forest Service-began with the planting of 33 tree species and seven grass species on six sites in 1971. The goal was to identify species which could survive under Kahoolawe's harsh conditions and eventually serve as host for less hardy native plants by acting as windbreaks and improving the site.

Of the 13 species planted at the highest elevation site, the best four at age 20 had survival ranging from 53 to 93 percent, average heights from 4 to 6 meters (12 to 20 ft.), and average diameters from 8-18 cm (4 to 7inches). These species are tamarick, shortleaf and longleaf ironwoods, and lemongum eucalyptus (*Eucalyptuscitriodora*).

Eventually, large areas must be planted to control erosion and if possible, restore native vegetation. For years, goats were a tremendous problem, requiring fencing of all test sites, but recently the Navy eradicated these animals.

Future plans

Foresters are now focusing on methods required to restore vegetation. The experience of the past 20 years indicates that the hardy exotics, serving as pioneer species, must first become established, then native species can be underplanted. Research on the effects of fertilizer treatments on survival and growth will also be conducted.

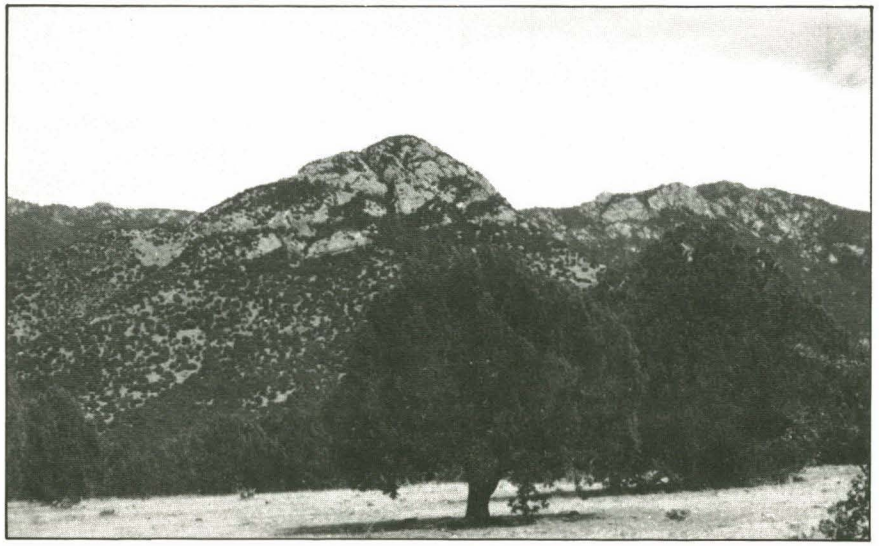
In recent years, the State and the Navy have established miles of windbreaks using tamarisk, one of the species that performed well in these species trials.

For additional information about this project, contact Mr. Craig D. Whitesell, Institute of Pacific Island Forestry, USDA Forest Service, 1151 Punchbowl Street, Room 323, Honolulu, Hawaii 96813.

A look at oak and associated woodlands

by Rick Fletcher
Rocky Mountain Station

There is a growing interest in the U.S. and Mexico in management of arid woodland ecosystems. Woodlands of the southwestern U.S. and northern Mexico have been, and continue to be, important sources of fuelwood, fenceposts, and other wood products. Of equal value, however, these woodlands also provide livestock forage, wildlife habitat, watersheds, and amenity values such as recreational use, birding, hiking, camping and scenery. Most previous forest land management and research efforts have been directed towards questions concerning the commercial timber types. But there is now an increasing awareness of the necessity to practice total ecosystem management — to plan and implement management practices that consider multiple values in these woodlands on a long-term, sustainable basis.

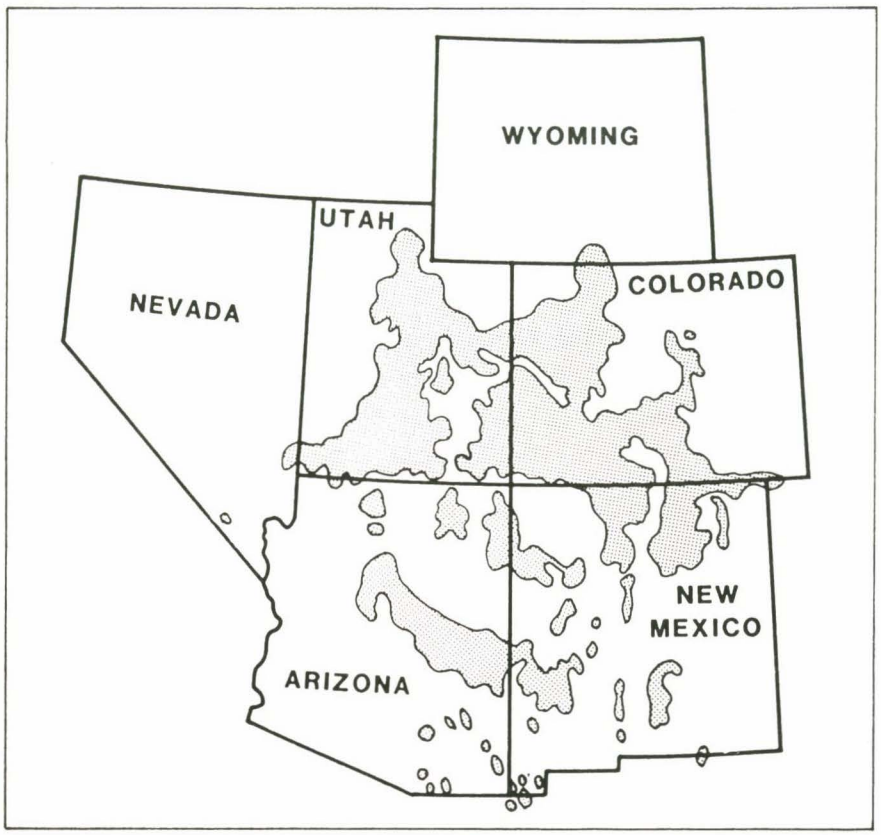


Oak woodlands on the Coronado National Forest in southern Arizona.

Arizona gathering

In the spring of 1992, a host of scientists, foresters, professors, and other experts met in Sierra Vista, Arizona, to exchange information and ideas on the management of oak and associated woodlands of the southwestern U.S. and northern Mexico. Twenty papers and nineteen poster presentations helped summarize the research knowledge and management experiences on ecology and silvicultural practices; growth yield and utilization potentials; livestock and grazing practices; wildlife habitats and values; and hydrology and watershed management in these woodland communities.

Former Rocky Mountain Station Director Hank Montrey (now working at USDA Forest Service headquarters in Washington, D.C.), who offered opening remarks at the symposium, explained the interest in these arid woodland ecosystems "One obvious reason is the sheer size of land area in this region containing this cover type — approximately 80,317 sq. km.," he said. Although much of this vegetation occurs in the Sierra Madre Occidental of Mexico, it is also an important vegetation type in southeasten Arizona, southwestern New Mexico, and parts of Texas. "Another reason," stated Montrey, "is that arid ecosystems are very sensitive to the natural variability of the climate and to the impacts of human activities. They recover very slowly after disturbances because of low precipitation and poor soil nutrient levels."



Distribution of Gambel oak.

"Finally," he said, "growing populations in the Southwest have increased existing, and added new, demands on these woodlands. Outdoor recreational needs have placed a strain on the economic resources of land management agencies and, in places, on the ecosystems they are stewards for. A challenge to land managers is to ensure suitable habitat for the unique and common wildlife and plant species while continuing to satisfy other concerns."

For more information

The proceedings that have resulted from this symposium have been published and will serve as a vehicle for technology exchange, and as a basis for future research. If you would like a copy, write the Rocky Mountain Station and request *Ecology and Management of Oak and Associated Woodlands: Perspectives in the Southwestern United States and Northern Mexico*, General Technical Report RM-218.

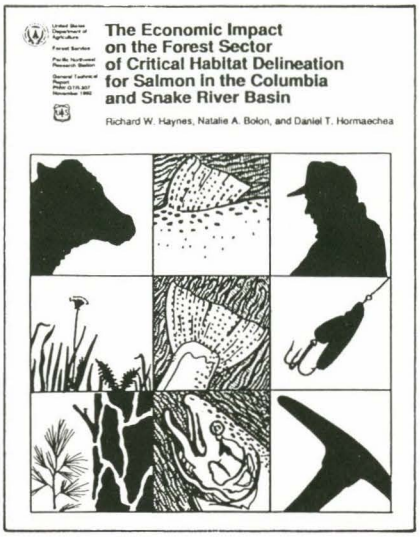
New from research

Assessment of the biological and economic implications of critical habitat designation for salmon

Assessment of the biological and economic implications of critical habitat designation for salmon

The National Marine Fisheries Service, in anticipation of the listing of various salmon runs in the Columbia and Snake River basins as endangered under the Endangered Species Act, is attempting to assess the biologic and economic implications of critical habitat designation for salmon.

The economic assessment includes nine major areas of direct economic impacts: flood control, irrigated agriculture, hydropower production, transportation and navigation, recreation, salmon fisheries, land management, municipal and industrial water use, and nonsalmon wildlife and fish and riparian wildlife.


The Economic Impact
on the Forest Sector
of Critical Habitat Delineation
for Salmon in the Columbia
and Snake River Basin
Richard W. Haynes, Natalie A. Bolon, and Daniel T. Hormaechea

Request *The Economic Impact on the Forest Sector of Critical Habitat Delineation for Salmon in the Columbia and Snake River Basin*, General Technical Report PNW-307, available from the Pacific Northwest Research Station.

The role of standards in wilderness management

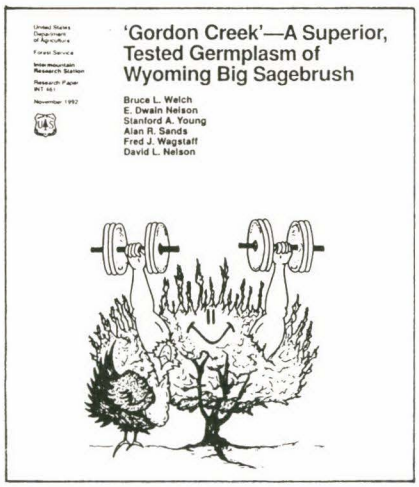
The 14 papers in this proceedings resulting from a 2-day interactive workshop represent the collaborative efforts of wilderness managers and researchers to assess the current use of ecological, social, and management standards integral to maintaining wilderness quality.

Another objective of the workshop was to summarize and integrate what has already been learned about wilderness management, capitalize on the diversity of this work, and develop ideas about directions for the future.

Request *Defining Wilderness Quality: The Role of Standards in Wilderness Management—A Workshop Proceedings*, General Technical Report PNW-305, available from the Pacific Northwest Research Station.

A superior sagebrush passes final exams

Scientists have learned that a particular kind of Wyoming big sagebrush, known as "Gordon Creek", sagebrush contains the germplasm or genetic material that makes it superior forage for deer and sage grouse. This variety exceeds typical winter forage values for energy, crude protein, phosphorus, and carotene. Deer showed that they prefer it by a wide margin compared to 12 other sagebrushes tested.



The team of six researchers tested "Gordon Creek" in three uniform gardens along with the other varieties collected from Utah, Idaho, Arizona, Oregon, Colorado, Wyoming, and Montana. This "super sagebrush" is adaptable to planting in a wide area of the West on sites that: get at least 10 inches of rain annually, have well-drained soils with not more than 55 percent clay, have a soil pH between 6.6 and 8.8, and have at least an 80-day growing season.

It is superior to "Hobble Creek," another "super sagebrush," on more arid sites with less than 14 inches of annual precipitation. This publication provides detailed information on how this sagebrush can be successfully established in new areas.

Request *Gordon Creek—A Superior Tested Germplasm of Wyoming Big Sagebrush*, Research Paper INT-461, from the Intermountain Research Station.

Conservation centennial symposium proceedings

The Forest Service is responding to the wishes of Americans to practice conservation and multiple use with increased environmental sensitivity. A new approach, called "New Perspectives", is changing the way the agency conducts planning and research and involves people in the management of Forest Service lands. In late 1991, three symposia were held in the southwestern U.S. with the theme "A Light of Evolving Ecological and Cultural Values". Topics discussed include: the environmental history of northern New Mexico; the Forest Service and environmentalism; perspectives on people, wood, and ecological thinking in forest conservation; living with the land; the social context of New Perspectives; Forest Service research in the Southwest; New Perspectives and Forest Service research for the southwestern pinyon-juniper woodlands; a look at the National Park System; New Perspectives and conservation; and a look at history and culture in the Southwest.

Copies of *A Southwestern Mosaic: Proceedings of the Southwestern Region New Perspectives University Colloquium*, General Technical Report RM-216, are available from the Rocky Mountain Station.

Lumber and plywood production and prices

Current information on lumber and plywood production and prices; employment in the forest industries; international trade in logs, lumber, and plywood; volume and average prices of stumpage sold by public agencies; and other related items is provided.

Request *Production, Prices, Employment, and Trade in Northwest Forest Industries, Second Quarter 1992*, Resource Bulletin PNW-194, available from the Pacific Northwest Research Station.

New FORPLAN guide available

In 1980, land managers, planners and other resource specialists were introduced to a computer software system called FORPLAN Version 1. It was developed to help merge timber and land management planning, and address the issues of integrated resource planning on national forests. It became the "required primary analysis tool" for use in forest planning. FORPLAN Version 2 was introduced in 1983 and contained significant improvements over Version 1.

A new publication has been issued that provides information on installing, using and troubleshooting Version 2 on MS DOS2 microcomputers. (Earlier uses were limited to mainframe computers; later efforts to move FORPLAN to a more "user friendly" PC environment were only partially successful.)

This guide includes information on the hardware and software needed to run FORPLAN on a micro platform, the steps necessary to obtain and execute FORPLAN, and information on the most current software and utilities that deal with FORPLAN analysis in a microcomputer environment. The authors point out that the guide does not explain what FORPLAN is, how to prepare data input, or how to address the issues related to planning analysis.

If you would like a copy of *Operations Guide for FORPLAN on Microcomputers (Release 13)*, General Technical Report RM-219 (which replaces *FORPLAN Version 2: Operations Manual)*, write the Rocky Mountain Station.

What do people like or dislike when they view landscapes?

Visitors to wildland areas of the United States see an untold variety of natural and manmade features that comprise our natural landscapes.

This paper offers a different approach to evaluating public perception and opinion of managed landscapes. It illustrates what a segment of the public saw in slides of managed and natural landscapes, and identifies their likes and dislikes.

The goal of this paper is to provide managers with a better understanding of public concerns for the visual impact of resource management practices on wildlands.

For a copy, please request *Managed and Natural Landscapes: What Do People Like?*, Research Paper PSW-213 from the Pacific Southwest Research Station.

New reference for ecology and management of riparian shrub communities

The symposium on the ecology and management of riparian shrub communities held in 1991 in Sun Valley has resulted in a published proceedings with 44 papers that provide managers with a wealth of scientific information from which they can develop riparian management alternatives.

The papers provide information on riparian shrub ecology, classification of communities, grazing effects, rehabilitation, and the ecology and management of upland shrubs. The symposium and this collection of papers meet an urgent need by resource managers to acquire scientific information about the most ecologically valuable areas of the arid West.

Request *Proceedings—Symposium on Ecology and Management of Riparian Shrub Communities*, General Technical Report INT-289, from the Intermountain Research Station.

To order any of the publications listed in this issue of *Forestry Research West*, use the order cards below. All cards require postage. Please remember to use your Zip Code on the return address.

Please send the following Pacific Northwest Station publications:
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1) *Production, Prices Employment, and Trade in Northwest Forest Industries, Second Quarter 1992*, Resource Bulletin PNW-194.
2) *The Economic Impact on the Forest Sector of Critical Habitat Delineation for Salmon in the Columbia and Snake River Basin*, General Technical Report PNW-307.
3) *Defining Wilderness Quality: The Role of Standards in Wilderness Management—A Workshop Proceedings*, General Technical Report PNW-305.
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Please send the following Rocky Mountain Station publications:
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1) *Ecology and Management of Oak and Associated Woodlands: Perspectives in the Southwestern United States and Northern Mexico*, General Technical Report RM-218.
2) *Rocky Mountain New Perspectives: Proceedings of a Regional Workshop*, General Technical Report RM-220.
3) *A Southwestern Mosaic: Proceedings of the Southwestern Region New Perspectives University Colloquium*, General Technical Report RM-216.
4) *Operations Guide for FORPLAN on Microcomputers (Release 13)*, General Technical Report RM-219.
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Please send the following Intermountain Station publications:
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1) *Vegetation, Nesting Bird, and Small Mammal Characteristics—Wet Creek, Idaho*, General Technical Report INT-293.
2) *Gordon Creek—A Superior Tested Germplasm of Wyoming Big Sagebrush*, Research Paper INT-461.
3) *Plant Community Diversity After Herbicide Control of Spotted Knapweed*, Research Paper INT-460.
4) *Proceedings—Symposium on Ecology and Management of Riparian Shrub Communities*, General Technical Report INT-289.
5) Other _____

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Please send the following Pacific Southwest Station publications:
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1) *The California Spotted Owl: A Technical Assessment of Its Current Status*, General Technical Report PSW-133.
2) *Managed and Natural Landscapes: What Do People Like?*, Research Paper PSW-213.
3) *Estimating Erosion Risk Associated with Logging and Forest Roads in Northwest California*, a reprint.
4) *Proceedings of the IUFRO Technical Session on Geomorphic Hazards in Managed Forests*, General Technical Report PSW-130.
5) *Monitoring Visitor Use in Backcountry and Wilderness : A Review of Methods*, General Technical Report PSW-134.
6) *Site Preparation Affects Survival, Growth of Koa on Degraded Montane Forest Land*, Research Paper PSW-205.
7) *Proceedings of the Symposium on Oak Woodlands and Hardwood Rangeland Management*, General Technical Report PSW-126.

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New perspectives in the Rockies

"New Perspectives" was the centerpiece of discussion at a 1991 workshop held in Denver, Colorado. The meeting brought Forest Service management and research personnel together with university faculty from the Rocky Mountain region to develop strategies for management, research, education and extension for natural resources in the 1990's.

Proceedings from this workshop have now been published by the Rocky Mountain Station. Topics include: an ecological view of New Perspectives; human dimensions in natural resources management; the changing policy environment in the West; reflections on New Perspectives; plus others.

For a copy, request *Rocky Mountain New Perspectives: Proceedings of a Regional Workshop*, General Technical Report RM-220.

Erosion risk resulting from logging and road building

Erosion resulting from logging and forest road building has long been a concern to forest managers and the general public. Such concerns recently led to a number of studies on this subject in California.

Results of this study and the appraisal of the interdisciplinary team that collected the data suggests that site conditions are more important than management practices in determining the erosional consequences of logging or road construction. Equations developed in this study can be used by forest managers during their planning process to estimate the erosion risk of proposed activities.

For a copy of *Estimating Erosion Risk Associated with Logging and Forest Roads in Northwest California*, please request a reprint from the Pacific Southwest Research Station.

Current status report on the California spotted owl

This report is based on the findings by the Technical Assessment Team to the Interagency Steering Committee for the California spotted owl assessment.

This report covers the assessment of the current status of the California spotted owl, its biology and habitat use, and forests where the subspecies occurs in the Sierra Nevada and southern California. The report suggest the direction of future inventories and research, identifies projected trends in habitat, and offers guidelines and recommendations for management of the California spotted owl.

For a copy of *The California Spotted Owl: A Technical Assessment of Its Current Status*, please request General Technical Report PSW-133 from the Pacific Southwest Research Station.

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